Albedo Adventure - Brooke Petrucelli

Grade/ Grade Band:6	**Topic:** Understanding Earth's Energy Budget	**2-3 50 min lessons**

Brief Lesson Description: Students will understand albedo, create spreadsheets and infographic based on Earth's energy budget.

Performance Expectation(s): Students will develop an infographic based on the data gathered from the Earth System Data Explorer. They will demonstrate their understanding of how light and radiation is absorbed and reflected from different earth surfaces, seasonal change and the balance of energy flowing in and out of the earth system.

Specific Learning Outcomes: Students will be able to describe how surface material type and color, affect how the sun's radiation is absorbed on Earth's surface. - Students will be able to describe what the Global Energy Budget is and how energy flows through the various parts of the Earth system.

Standard: NGSS - MS-ESS2-1 Earth's Systems

MS-ESS2-1.	**Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.**	

Science & Engineering Practices:	**Disciplinary Core Ideas:**	**Crosscutting Concepts:**
Developing and Using Models Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. • **Develop and use a model to describe phenomena.**	**ESS2.A: Earth's Materials and Systems** • **All Earth processes are the result of energy flowing and matter cycling within and among the planet's systems. This energy is derived from the sun and Earth's hot interior. The energy that flows and matter that cycles produce chemical and physical changes in Earth's materials and living organisms.**	**Stability and Change** • **Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and processes at different scales, including the atomic scale.**

LESSON PLAN – 5-E Model

ENGAGE: Watch video of Earth's Energy Budget https://www.youtube.com/watch?v=ZqJ1D6lqVgo

This is a great simple introduction to the idea of energy coming from the sun, being absorbed by the ocean and vegetation and reflecting off of lighter colored surfaces. Introduce vocabulary: reflection, absorption, radiation, albedo, conduction, convection infrared, flux.

Discuss a budget - then discuss that the Earth energy budget is similar.
View this video - https://www.youtube.com/watch?v=sCxIqgZA7ag The world is black and white - Daisy World - Simple explanation of albedo. Discuss for understanding. Students will use a padlet wall (https://padlet.com/) to post thoughts or questions that they have about albedo on light and dark surfaces including water, ice, vegetation.

EXPLORE: Lesson Description – Materials Needed / Probing or Clarifying Questions:

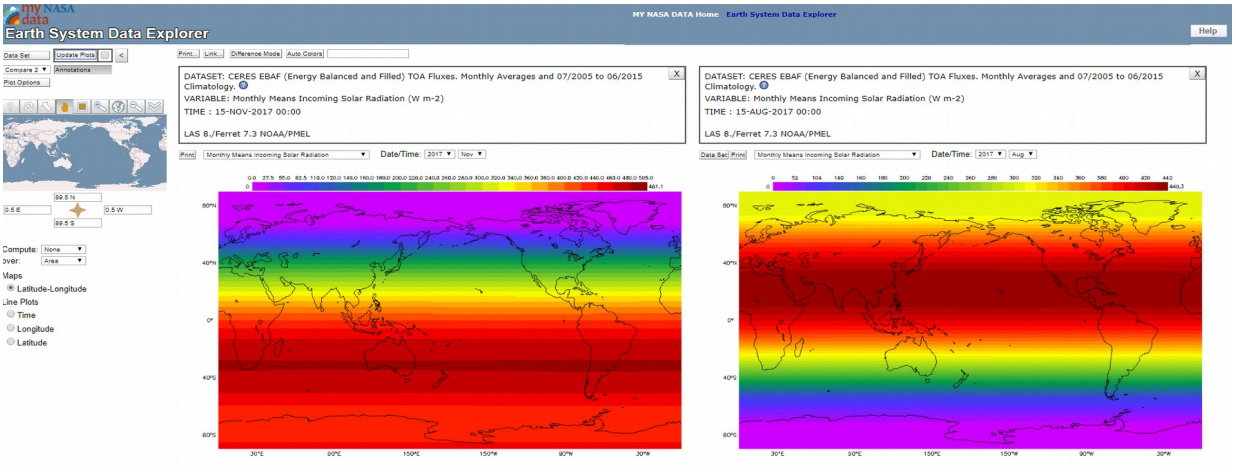
Students will pair up and go to the Earth System Data Explorer. https://mynasadata.larc.nasa.gov/EarthSystemLAS/UI.vm They will create a spreadsheet and record 5 different years and compare maps for summer months to winter months. They will record this in a Google Sheet - and can plot data points with colors as represented on the maps. They will choose 4 different areas to plot - Students can choose approximate location but should

have a good representation different points on the globe (i.e. New England, Sahara Desert, Amazon Rainforest and Alaska.)

This is an example of comparing two maps. Each pair of students will record information for different variables:

- Monthly Means Incoming Solar Radiation
- Monthly Albedo Reflected from Top of the Atmosphere with Clouds(CERES EBAF) (fraction)
- Monthly Net Solar Radiation with Clouds (CERES EBAF) (W m-2)
- Monthly Snow/Ice Percent Coverage (CERES) (percent)

Student pairs will share their graphs and experience and discuss what they think is happening with their systems.



EXPLAIN: Concepts Explained and Vocabulary Defined:

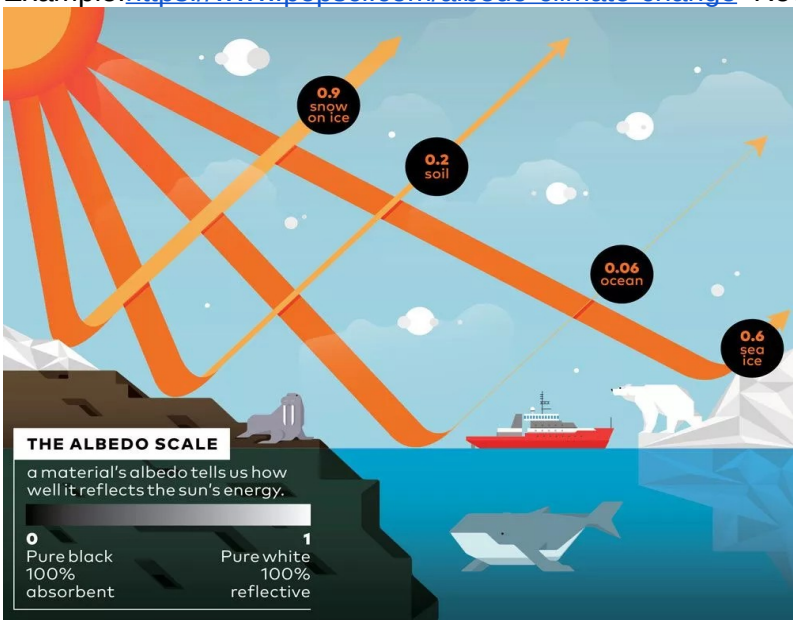
The global energy budget describes the ways solar radiation from the sun is used in the various parts of the Earth system: atmosphere, hydrosphere, biosphere and geosphere. Depending on factors such as clouds and surface albedo (how much of the radiation hitting a surface is reflected versus being absorbed), the balance of the system can change. In a monetary budget, "balancing the budget" means knowing where all the money is spent, and 2 having an equal amount coming in as going out. In the Earth system, instead of money, we think of energy. For the system to be balanced, all the energy coming from the sun must be accounted for, and the energy coming into the system must equal the energy leaving the system. An imbalance in the system (such as what has happened with the increase in greenhouse gases) can cause changes to temperature, precipitation patterns and sea level, among other effects. Although the lab activities described here are intended to help students grasp the way the system works and do not directly address these results, part of NASA's mission is to help understand and predict these environmental changes -
Teacher Guide: Earth's Global Energy Budget Teacher Guide [PDF]. (n.d.). GPM.NASA.gov.education.

Have students view and work with this interactive - Earth's albedo and global warming.
https://nhpbs.pbslearningmedia.org/resource/ipy07.sci.ess.watcyc.albedo/earths-albedo-and-global-warming/#.WyPuc6dKiUk

Vocabulary: Review Definitions from Intro

ELABORATE: Applications and Extensions: Show the students different biomes from a Minecraft world and have the students formulate ideas about a Minecraft albedo. Have student pairs create an visual infographic with information from their spreadsheets and describe what is being reflected or absorbed and if anything indicates an imbalance or not. (Infographic maker https://www.canva.com/create/infographics/

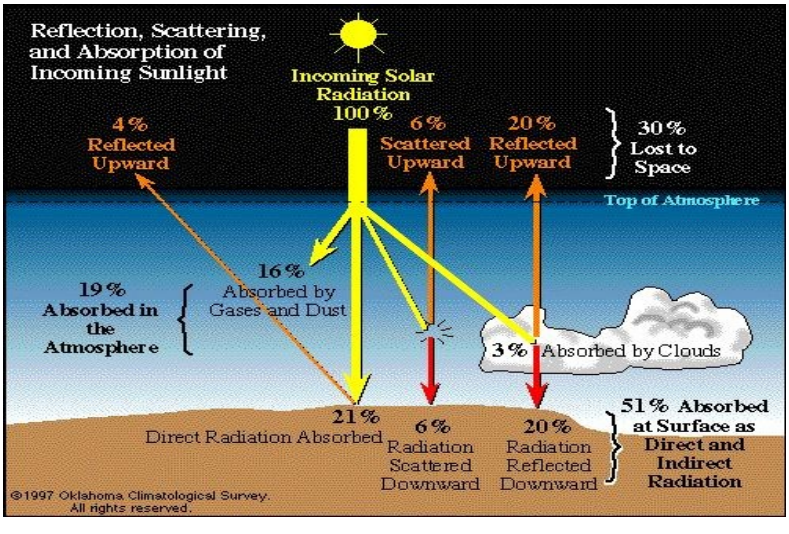
Example:https://www.popsci.com/albedo-climate-change Review Article and view infographic.



Pierre-Louis, K. (2017, July 7). 30 percent of the energy sent to Earth bounces back into outer space. Climate change could upend that. *Popular Science*.

Image by Valerio Pellegrini

Additional Example:



EVALUATE:

Formative Monitoring (Questioning / Discussion): Participation, discussion and padlet entry

Summative Assessment (Quiz / Project / Report):
Spreadsheet and infographic completion
Rubric - spreadsheet - points for effort,data, location and organization, collaboration with team mate
Rubric - spreadsheet - points for effort, organization, information,visual representation, thoughtful graphic and collaboration with team mate.

Elaborate Further / Reflect: Enrichment:
Create an infographic using a minecraft map with different biomes and structures and ocean.

Create an additional spreadsheet using the variables for biosphere.

Resources:

Earth's Energy Budget. (n.d.). Retrieved June 12, 2018, from http://okfirst.mesonet.org/train/meteorology/EnergyBudget.html

Earth's Atmosphere. (n.d.). Retrieved June 16, 2018, from https://www.windows2universe.org/earth/Atmosphere/overview.html

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